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This report contains information on national-level science policies, technology strategies, and research and development programs in West European science and technology in general and specifically in civil technology, with particular attention to transportation, energy, chemical manufacturing, industrial automation and technology transfer. The report will focus primarily on France and the Federal Republic of Germany, but will also cover important developments in Italy, the Netherlands, Sweden and other West European countries.

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MISSION, ACTIVITIES OF CNEXO REVIEWED, CRITIQUED

Paris AFP SCIENCES in French 20 Dec 79 pp 6-7

[Text] Paris--The role of the CNEXO is coordination above all. In the Revenue Court's report on public enterprises, the National Center for Exploitation of the Oceans (CNEXO) is taken somewhat to task. A certain number of reproaches are made against it, the most important of which is that of having overdeveloped its own research facilities and the number of research personnel, while one of its principal missions is to coordinate the research and development programs of all organizations interested in oceanology. Its second mission, on the other hand, is its own development of expertise in the work, studies and operations of this sector.

The Revenue Court particularly emphasizes that:

--The CNEXO is oriented toward establishment of important research units of its own, which enter into competition with the other laboratories.

--A rigorous policy of choice of programs and selection of activities has become necessary. In particular, it seems difficult to allow the institution itself to conduct basic research which in reality is above and beyond the activities corresponding to the mission given to it by the 1967 law.

--The number of research personnel has increased yearly to the detriment of personnel responsible for the tasks of coordination and management which are, nevertheless, an essential part of the organization's activities: at the end of 1977, 120 research personnel were officially on the rolls of the Center, compared to 49 in 1972; i.e., one-third of the budgeted staff; however, in reality, two-thirds of the personnel officially on the rolls are engaged directly in both basic and applied research.

A more astounding criticism made by the Revenue Court concerns studies made by the CNEXO on polymetallic nodules. The center has been reproached for having devoted an increasing share of its resources (2.4 MF in 1972, 19.4 MF in 1976) to these studies, while the profitability of industrial exploitation of the nodules is still far from being demonstrated. In particular, the technical problems posed by exploitation (locating of deposits, extraction, processing) have not been resolved. To do so would require a financial effort which is not within the Center's financial capabilities. Moreover, contracts which have reached for this purpose with private industry leaves all the risks to the public enterprise, without adequate offsetting return.

The Revenue Court's report underscores the fact that the CNEXO has given assurance that the exploration of sites would end in 1979.

As concerns investments, the Revenue Court particularly reproaches the Center for the amount of maintenance costs of the Brittany Oceanological Center; i.e., 4.5 MF in 1977, and the procedure used for the installation of the Mediterranean Oceanological Base.

As regards the management of ships, the CNEXO is asked to make "an organization and coordination effort in the utilization of sea resources, which is not always rational."

Finally, with respect to the Center's public image, it is recognized, on the other hand, that despite costs which seem to be high, "contrary to other organizations, the CNEXO has been able to make itself known."

A certain number of criticisms addressed to the CNEXO cause some surprise, when one considers the effort exerted by other countries in the oceanology sector, particularly in the FRG and Japan, without mentioning the USSR and the United States.

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MINISTER, OFFICIALS DISCUSS METROLOGY POLICY

Paris AFP SCIENCES in French 20 Dec 79 pp 2-6

/Text/ Paris--Andre Giraud suggests that 1981 be "the year of quality in industry." Expressing homage on 13 December to the performance of the National Bureau of Metrology (BNM) on the occasion of its 10th anniversary, Minister of Industry Giraud, developing a subject which is dear to him, that of a "national strategy of quality," suggested that 1981 be "the year of industrial quality."

After indicating that "the quality of industrial products appeared to him to be of prime importance," that "the requirement of quality is a commercial argument which can turn out to be decisive" and that "the logic of quality is the necessary complement to the logic of price," Giraud added that, in order for this sensitivity, this requirement of quality to spread, not only among the heads of business but also among the public at large, he was proposing that, at the Congress of the European Organization for Quality Control to be held in Paris in June 1980, the year 1981 be declared "the year of quality in industry."

Giraud also announced that, in order to prevent "the proliferation of fanciful labels" and enable the public to become familiar with fewer but more meaningful warranties, "special procedures will be put into effect to implement the Scrivener Law of 10 January 1978 on consumer information and protection: a quality warranty which will be characterized by a clearly worded label and will guarantee that the inspection control indicated is genuine. According to the minister, for nearly 2 years the decree in question has given rise to very broad discussion, sometimes heated, among the administration, industrialists and consumer organizations. It is currently being reviewed by the Council of State and is expected to be published within the first few weeks of 1980."

In addition to its purely scientific aspect of defining basic dimensions in an increasingly precise manner, the BNM role is specifically to furnish industrialists norms and means for achieving strict standardization and flooding technical and industrial circles with information to give them a satisfactory and accessible "link" with national measurement standards. Thanks to "standardization chains," formed by means of about 60 qualified standardization centers and metrology services, it has been possible to award more than 60,000 certificates of standardization in about 10 years.

Giraud stated that in 10 years "nearly 90 million francs have been devoted by the BNM to the financing of basic and applied research putting us in a competitive position in such spheres as laser interferometry, the measurement of pressures and forces, the mastering of atomic chronometers and applications of the Josephson effect in electric measurements."

The minister outlined the action with which the BNM is to concern itself in the near future:

--ascertain any new requirements in such sectors as telecommunications, data processing, biomedicine, energy, mechanical construction, nuclear energy and the like to establish a real multiannual study program.

--clarify its interventions and interactions with the development of the French instrumentation industry, a sector which has been given priority status in the drawing up of development contracts.

--develop the activity of technical assistance to firms and other services it renders (documentation, means for standardization, reference material).

--lastly, take part in the overall action to be carried out within the scope of a genuine national strategy aimed at achieving better quality.

Before Giraud spoke, speeches had been given by Georges Denegre, BNM secretary general, and Claude Frejacques, member of the institute and chairman of BNM's management committee.

Denegre first gave an account of the action studied and taken by the BNM.

"Since its establishment," he said, "our activity has been divided into sectorial groups in order to take advantage of the elements involved in elaborating a program; these are:

--spectroradiophotometry
--mechanics
--electricity
--time, frequency
--ionizing radiation
--temperature, thermodynamics
--physicochemistry
--reference materials.

"These eight groups were soon supplemented by an "industry liaison" committee given the task of studying ways to disseminate engineering results and standards information among the users and how to guarantee measurements made. This committee is credited with devising the current systems of standardization chains as well as the procedure for evaluating and qualifying the measurement instruments; the system relative to reference materials came later and was the result of fruitful cooperation with similar studies made on a European level.

"That in a nutshell is what happened during the last 10 years. A total of 312 engineering contracts were launched. In truth, the real beginning took place only after 2 years of reflection, after interest in the existence of a BNM was confirmed. Most of the studies were preserved in the form of reports which are available at the BNM office. The studies made it possible to achieve primary standards, transfer standards and standardization reference equipment. It is these results and equipment as a whole which made it possible to construct the network of standardization chains, the real spinal column of the BNM organization, and which resulted in the philosophy behind our action: guarantee measurements by depending on references which are themselves guaranteed."

In this connection, Denegre pointed out that, since the beginning, the BNM has worked in close cooperation with the Bureau of Measuring Instruments. He then presented the distribution of the BNM studies. "The overall amount devoted to this action comes to 89.5 million francs," he stated. "It may also be of interest to compare the financial effort made by France to that of other nations. This comparison is difficult as, in a number of countries where there is federal organization, metrology is included in an establishment with a multiple vocation (engineering, technology, experimentation and the like)."

Denegre gave the following approximate average figures covering the last 5 years and using the ratio: foreign organization divided by BNM:

--United States (National Bureau of Standards)	11.5 approximately
--FRG (PTB)	6.77 approximately
--Japan	10.00 approximately
--United Kingdom (NPL)	4.4 approximately

"However," Denegre added, "these ratios are pared down in the BNM's favor, since the French laboratories share in the overall budget allocated to metrology in the form of equipment. We may conclude that, with our limited resources, the examples given indicate this; that is, French metrology and measurements show up quite well on the international scene but only provided the effort of the last 10 years is not relaxed and particularly stepped up."

In turn, Frejacques presented a picture of the BNM organization and its future orientations. First, he indicated the four primary laboratories which are responsible for preserving and improving the national standards. These are as follows:

--The National Institute of Metrology of the CNAM /National Confederation of Arts and Crafts/, directed by Professor Alisy, responsible for measurements of length, mass, pressure, temperature and light.

--The primary laboratory for time and frequency, directed by Mr Ruthman.

--The primary laboratory for electricity, located at the LCIE /Central Laboratory for Electical Industries/ and directed by Mr Olmer, assisted by Mr Blouet, for measurements of electricity and magnetism.

--The laboratory of the Metrology of Ionizing Radiation, directed by Mr Legrand.

This primary arrangement is supplemented by the system of standardization chains whose administration is in the hands of the BNM's permanent secretariat under the direction of Mr Denegre. This system comprises:

--approved centers of standardization, true secondary laboratories of metrology, which are the direct intermediaries of the end user or manufacturer of measuring instruments, which award official certificates of standardization and whose competence and agreement with primary standards are guaranteed by the BNM.

--qualified metrology services within the companies themselves whose quality of methods, instrumentation and manpower have been recognized by the BNM.

"The 17 approved centers of standardization and the 56 qualified metrology services make up the spinal column of the BNM," Frejacques stated. "They made more than 70,000 standardization verifications last year, and this figure is increasing by 15 percent each year. The quality of this standardization sytem is recognized internationally. Its rational approach and its relatively low cost are resulting in numerous demands for information and collaboration by foreign countries. However, I would be remiss if I did not point out the relative lack of funds in the possession of our primary laboratories: the Germans spend 6 times more, the Japanese 10 times more and the Americans 12 times more than we for metrology; the results are apt to be serious, for metrology involves norms and a certain psychological and factual advantage to the country which has established those norms.

"The BNM's interministerial role is assured by the participation in the management committee of representatives of the Ministry of Universities, the Ministry of National Defense, the Ministry of Health and the Ministry of Telecommunications. Representatives of AFNOR /French Standardization Association/, of the Bureau of Measuring Instruments, of the Bureau for the Quality of Industrial Products, of large organizations and of industries assure liaison downstream. I wish to express thanks to all of them for their effective and constructive participation in this collective work," Frejacques stated.

"Let us now turn," he continued, "to the changes to be made to the system. A critical study on the activity of the BNM and an evaluation of metrology in France had been assigned by Pierre Aigrain, my predecessor and the current secretary of state for research, to a foreign organization--the Center for Studies on Research and Innovation. The conclusions of the studies made by Prof Saint-Paul are arriving just in time for an in-depth examination of the past 10 years.

"They confirms the extent of the demand for standardisation by industry and recognition of its decisive influence on the quality of production. They stress the demand made by small and medium-sized industry, particularly in the provinces, which will require increased effort by the BNM in the regional scope. They draw attention to the need, revealed by numerous inquiries, for metrology of very high quality for the development of automation. In fact, these combined systems require internal self-inspection for which the standards themselves must be connected with secondary standards. This is a new area in the midst of development in our standardisation chains. Even the agricultural food industries are requesting the BNM's assistance in this sector," Frejacques concluded.

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FRANCE

GOVERNMENT, BUSINESS LEADERS DISCUSS R&D IN INDUSTRY

Colloquium of 27 October

Paris AFP SCIENCES in French 31 Oct 79 p 1

[Text] Paris--Research and development work achieved in industry: A small number of businesses (about 1,000) are responsible for initiating research and development work, it was noted by Mr Pierre Aigrain, secretary of state in charge of research, as he addressed participants in a seminar organized on 27 October by the Training Center for International Realities.

The larger firms represent some 60 percent of the total research and development effort, measured in terms of expenditure as well as personnel.

In addition, certain crucial sectors account for a large part of R and D activity, for instance:

--Aeronautics	22 percent
--Electronics	18 percent
--Automotive	10 percent
--Energy	7 percent
--Data Processing	5 percent

On the other hand, other, more traditional, sectors (machinery, food and agricultural industries, building and textiles) only play a minor role in the R and D effort. Those sectors will therefore benefit from the cooperative programs initiated within the framework of the 10-year research plan: first, food, machinery and materials [industries] where small and medium-size businesses are chiefly involved. The recent reform of the National Agency for the Valorization of Research [sic] [ANVAR], is one element of that policy, the minister concluded.

Colloquium of 21 November

Paris AFP SCIENCES in French 22 Nov 79 pp 3, 4

[Text] Paris--Colloquium on innovation and research: During the colloquium on "Innovation and Research--Survival of Our Economy," held by the CNPF

[National Council of French Employers] on 21 November, Mr Pierre Aigrain, secretary of state in charge of research, urged industrialists to "do their duty" and forge ahead in the field of research, with government aid.

The minister's intent was to encourage industrialists to increase the portion of business expenditures devoted to research and development. For its part, the CNPF had already suggested, at the start of the colloquium, that each business devote one percent of investments to innovation.

According to Mr Aigrain, there are other methods which, by increasing the research outlay on the part of business, would make it possible to reach the 2.2 percent objective set by government for gross national expenditure on research, computed in relation to the gross domestic product (PIB) and thus [make it possible to] equal the FRG's effort (as opposed to the current 1.8 percent).

Business firms should have a desire to gain access to the stupendous stock of the large public research organizations, a veritable gold mine, the minister continued. In addition, this would enable them to be in touch with the highest levels of international research.

All small and medium-size firms should therefore have their own "counsel" originating from the CNRS [National Center for Scientific Research] or from some other state research agency, the minister concluded, pointing out that on the average French firms recruit five times fewer research workers from government agencies than, for instance, a country such as the Netherlands. In laboratories, however, "hybrid" recruiting can make it possible to obtain very convincing results.

Mr Francois Ceyrac, president of the CNPF, stressed "the tremendous research effort needed in order to stabilize employment and improve living conditions." In Mr Ceyrac's opinion, such an effort is particularly urgent in view of the fact that the annual increase in research expenditures has been a mere 5 percent, as opposed to 15 percent before 1977.

Mr Olivier Lecerf, chairman of the CNPF's "innovation and research" committee, suggested that firms devote 1 percent of their investments to innovation, without regard for immediate returns.

In this field, France's position is not as satisfactory as it should be, he pointed out. Indeed France is in fourth place, following the United States, the FRG and Japan, with respect to percentage of gross domestic product devoted to research.

As for Mr Alain Chevalier, CNPF vice president, he declared that the forthcoming industrial redistribution will have as momentous repercussions as did the industrial revolution of the Nineteenth Century.

Seen from that angle, France's efforts must be centered on high technology and high value-added sectors, including, among others, biochemistry and micro-computer technology. However, Mr Chevalier added, nearly all branches of industry are involved, and no sector should be contemplated as being doomed.... The most traditional industries will also have to learn to seize their opportunity, he concluded.

In closing the colloquium, Mr Andre Giraud, minister of industry, stated: "From now on, innovation will be the reply of an active intelligence to the challenge of the years to come," adding that: "Our nation lacks neither research workers nor inventive minds. Its greatest fault lies in not using them."

Mr Giraud recalled the resources provided for businesses in that field: an innovation bonus amounting to 25 percent of research costs, and aid to innovation distributed by regional delegations of ANVAR [National Agency for Valorization of, and Aid to, Research].

The minister of industry encouraged innovators by pointing to the position of strength they could gain through a dynamic approach. Research would then guarantee the growth of a business and, far from being a risky investment, innovation would represent a type of insurance, Mr Giraud concluded.

Mr Lecerf's presentation included the following chart:

Research Conducted by Business in 1977 (in percentages of total research):

United States	70
Germany	64
United Kingdom	63
France	61
Japan	58
Italy	55

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FUTURE, IMPACT OF BIOMEDICAL RESEARCH EXAMINED

Initial Analysis

Paris LE MONDE in French 10 Nov 79 p 1

[Text] Mr Francois Gros, professor at the College of France and general director of the Pasteur Institute, Mr Francois Jacob, College of France professor and Nobel Prize laureate, and Mr Pierre Royer, professor at Paris-V University and adviser on biological and medical research to the General Delegation for Scientific and Technical Research, are scheduled on Monday, 12 November, to submit to the president of the republic the report which he requested from them nearly a year ago on the social and industrial repercussions of the development of all areas of biology (microbiology, molecular and cellular biology, "genetic manipulations").

Entitled "Sciences of Life and Society," this 300-page report, to be published on Tuesday, 13 November, by French Documentation, among other things assesses the important consequences which the development of this relatively young science could have in fields as different as medicine, energy, agriculture or oceanography, in particular by making it possible to produce new substances or to modify current production processes.

In a two-article series, which we will begin publishing today, Xavier Weeger makes an initial analysis of the development of biology, pointing out in particular what may be the advantages for France in this respect.

New Techniques, Capabilities

Paris LE MONDE in French 10 Nov 79 pp 1, 26

[Text] "Biology of our time is triumphant," Professor Jean Bernard wrote in this newspaper more than 5 years ago. And Pierre Thuillier, in a more recent article in LA RECHERCHE (March 1979), goes even further by asking: "Are biologists going to take over?" This question [illegible] the claims of sociobiologists to suggest, on "scientific" bases, a new and perhaps broader moral and political philosophy at a time when it is fashionable to prophecy that the age of biologists will soon follow the age of physicists.

Biology is fashionable today; no one could be unaware today of the probably fantastic--and most certainly, largely unforeseeable--spin-offs of this young science in its modern form (and whose birth was made possible precisely by physics). Without going into philosophical considerations of the lifetime of our societies or the future of the species, it is no doubt necessary today, from a scientific, technical and industrial standpoint, to try to determine what these "biotechnologies" may hold for us. It is said that they should penetrate the productive apparatus of our societies by the end of this century or in the beginning of the next.

The birth of modern biology dates back about 25 years, when two British researchers, Watson and Crick--soon rewarded with the Nobel Prize--explained the structure of the long "double-helix" molecule in which the genetic code is recorded in a manner common to all living beings.

Paralleling the considerable advances which modern genetics has since made, the availability to scientists of more and more refined and more and more powerful research tools has enabled them to gradually acquire a clear understanding of the basic vital workings of living organisms.

Today it is known with a great deal of accuracy how living organisms use the raw materials available in their immediate environments, transform them to produce new molecules, reproduce, etc.

Cellular biology, molecular biology, microbiology: a new vocabulary has been coined to christen the various branches of this science which gradually expanded and of which medicine was one of the first beneficiaries.

In the early seventies, biology took a new step forward, one which even makes it possible for many to speak today of a new age. Researchers learned why--particularly with regard to processing of the information contained in the genetic code--an elementary living organism (bacterium or cell) produces a certain substance by consuming another substance. They gradually learned how to monitor this activity, first in certain bacteria, in particular by causing them to perform syntheses of molecules which they normally did not do, by modifying the heredity of the microorganism and by including in its genetic material the instructions necessary to produce this new substance normally unknown to them. American, British and French teams in particular were thus able to command common bacteria--like Escherichia coli or Bacillus subtilis--to synthesize insulin, somatostatin or ovalbumin. The tool making it possible to perform this operation has been christened--depending on individual views--genetic engineering, in vitro genetic recombination (these two terms are favored by researchers who are "for" such research) or genetic manipulations.

Array of Methods

Other traditional or modern methods also make it possible to modify the genetic program of a living organism: man learned long ago how to cross species in the vegetable kingdom to modify their characteristics. A new method of much more recent vintage, cellular hybridization, is also very promising; for example, it makes it possible to produce "custom-made antibodies."* Thus there is a growing array of methods which should soon open the way to "production," almost at will, of living organisms capable of performing functions desired by man: we will be able to "put microorganisms to work" on a large scale.

This idea in itself is not new and the infinitely small organism has been serving higher ones for hundreds of thousands of years: certain plants can live only in symbiosis with a bacterium or fungus and man himself could not survive without the billions of microorganisms at work on his skin or in his intestinal flora. What obviously seems more novel is the idea of deliberately using the action of microorganisms to affect the world around us.

In fact, without knowing it, at least in the beginning, man has been putting microorganisms to work for a long time: wine, beer, bread, cheese, sauerkraut, to take just a few ordinary examples, owe everything or almost everything to the invisible action of colonies of yeast or bacteria.

"Bioindustry" or "biotechnologies" in themselves are not recent creations. And they have already been incorporated into very modern industrial plants, particularly in the pharmaceutical industry: for example, antibiotics, vaccines, vitamins and steroids are mass produced thanks to fermentation.

Many other branches of industry use this basic method: acetone-butanol has been produced by fermentation since 1917 and lactic acid since 1937. Half of French ethyl alcohol is produced by fermentation. An industrial group like Rhone-Poulenc estimates that four to five percent of its turnover originates in fermentation techniques.

Until now, the microorganisms used by industry to produce a very respectable number of different molecules are essentially the result of chance: under varied environmental and nutritive conditions, researchers try to see what bacteria and yeast found in nature can produce. Or taking colonies of microorganisms already at work producing this or that compound, they induce genetic mutations, for example, by exposing them to chemicals or radioactivity. The systematic study of these "mutant" microorganisms sometimes produces interesting properties: production of the same substance as in the beginning but with higher yields or growing conditions which are easier to guarantee or the production of new substances. In all cases, success is above all a question of chance.

The new genetic techniques will make it possible to simply disregard this factor of chance and to force the bacteria, yeast or cell to produce the substance selected by the "manipulator" and sometimes one far removed from what the organism produces naturally.

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*LE MONDE of 18 April 1979

This "rape of nature" is not without danger. A "manipulated" bacterium could quite possibly be provided, by chance or by the will of the "manipulator," with great pathogenicity, for example if modification of its genetic material should enable it to secrete a possibly unknown dangerous toxin. Supporters of genetic engineering reply that, among other instances, to produce vaccines many laboratories daily manipulate viruses or bacteria that may be fatal to man, but which have never caused a disaster. Moreover, they point out, in nature itself the processes of "genetic manipulation" sometimes occur spontaneously.

Another potential danger: the risk of ecological imbalance which could result from a new species of bacteria of plant capable of multiplying very rapidly, by means of special properties, at the expense of preexisting species. Here again, defenders of genetic engineering refer to nature, pointing out that it is precisely genetic mutations which are responsible for the origin of new species; thus this is a normal phenomenon.

These answers are not necessarily satisfactory and it is possible, for example, to draw a disturbing parallel with the "induced development" of certain species of microorganisms through the excessive use of antibiotics, which has led to the appearance of strains that are resistant to all known antibiotics.

Amazing Possibilities

Dangerous or not, this would be the first time in history that man would decide to "stop progress" by totally abandoning the new techniques of modern biology; above all, this would be to forgo apparently amazing possibilities.

Let's examine this: According to the eulogists of the new biology, it will simultaneously be able to solve problems of energy, world nutrition, pollution and waste, shortages of raw materials ... The enthusiasm must obviously be tempered, we will see, by external factors which will necessarily restrain the development of these techniques in one way or another.

In the medical field, for example, there will be biological production of hormones obtained today at great expense by very difficult syntheses or delicate processes of extraction from human or animal organs. Instead of administering a drug to a patient, it is also possible to expect that a colony of manipulated bacteria, capable of producing the required substance "on the spot," will be implanted in the intestinal flora.

In the agricultural and food sector, for example, it is possible to imagine the multiplication of vegetable species capable, like certain legumes, of fixing the nitrogen of the air, either with the assistance of "new" bacteria joined to their roots or by including this property in the genetic program of the plant. That would make it possible to eliminate very expensive nitrogenous fertilizers.

Similarly, it will perhaps be possible--certain achievements have already been made--to considerably develop the production of proteins of vegetable origin, such as by inducing the growth of yeast* capable of synthesizing these molecules.

In the energy sector, the production of methane from fermentation of organic or vegetable waste is already a reality. An attractive goal is the direct production of hydrogen by microorganisms (such as algae) which would be given the ability to synthesize an enzyme (hydrogenase) that could convert hydrogen atoms freed by photosynthesis into gaseous hydrogen.

In the industrial sector, entirely new products could be obtained from manipulated organisms: for example, "biopolymers" could produce artificial leathers. Or the controlled production of enzymes could completely change production processes, such as in the case of fine chemistry: a complex synthesis requiring many steps in "traditional chemistry" may give way to a single reaction of constituents on an enzyme. Such techniques already exist, such as the fixation of enzymes on a support (glass, plastic ...).

The in situ conversion of certain raw materials is possible by means of bacteria: in Canada, a uranium deposit is being exploited with bacteria converting, on the spot, certain sulfurs present in the ore, into sulfuric acid which solubilizes the uranium.

Agricultural or industrial waste can be utilized by means of bacteria contributing to the fight against pollution: General Electric is currently seeking a U.S. patent for a strain of bacteria capable of digesting hydrocarbons.

These ideas, for the most part, are no longer science fiction and industrialists are attentively following the development of all these new techniques, which can profoundly alter an entire series of technical "procedures."

Implications for Industry

Paris LE MONDE in French 11-12 Nov 79 p 9

[Text] The development of modern biology for several decades will make available to our societies new tools which, by sometimes using already existing techniques, could profoundly transform many areas of human activity, particularly industry (LE MONDE of 10 November).

Modern biology is not necessarily going to lead to the birth of a totally new industry. It will more likely penetrate many branches of industry, transforming their production processes or replacing certain types of production with others.

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*LE MONDE of 10 October 1979

There is hardly any doubt that the developments of biotechnologies are perfectly in keeping with new procedures. The government wants France to assume a leading position in this respect. These are actually promising industries in which "gray matter" will play a decisive role in developing unique strains of bacteria with interesting properties in research laboratories. The application and "employment" of these strains are the job of a high-technology industry: fermentation or more general procedures of "growing" microorganisms, as we have seen, do not require totally new concepts.

In already very keen international competition, at least up the line, it is clear that productivity and output will be of critical importance, particularly when it is a question of substituting new procedures for former techniques or creating entirely new products. Thus there is an intense need for applied research, particularly "real-time" process monitoring that will require, for example, the broad use of applied data processing or new sensor technologies. From this standpoint, the advantages and potential of French research and industry are far from being negligible.

In basic research, several French teams of the Pasteur Institute, the National Institute for Health and Medical Research (INSERM) and the National Center for Scientific Research (CNRS), particularly in Paris and Strasbourg, are among the best in the world. The same is true of the basic and applied study of enzymatic techniques, in Compiegne and Toulouse in particular. With regard to agronomy and food-agricultural operations, the teams of the National Institute for Agronomic Research (INRA) have a well established reputation; this organization signed a cooperative agreement with the Pasteur Institute several months ago.

Once again, this "generally positive assessment" must be modified: at least this is the opinion of an individual as well informed as Mr Philippe Laudat, general director of INSERM: "Of the 200 INSERM laboratories, if there are not, within the next 5 years, about 100 that have started to learn, indeed to practice, methods of genetic recombination, I maintain that within a short time French medical research will be f..." And Mr Laudat regrets that "despite existing incentives, researchers are not tempted to become involved in this revolutionary field." According to him, enzyme research, so promising from a therapeutic standpoint, also suffers from a lack of enthusiasm.

Pharmacy First

The situation in industry is obviously more difficult to analyze, since it involves so many different potential areas of application. It may be noted, first of all, that a great effort will obviously be required in the sector of food-agricultural industries, particularly inadequate in France. The situation is much better in the sector of azymes (Rapidase company, for example), proteins of vegetable origin (Eurolysine company) or derivatives of dairy products (Fromageries Bel group). The threat which biotechnologies may present to petrochemicals and the new possibilities foreseeable in the case of fine chemistry, as we will see, are not being ignored by the large industrial groups traditionally active in these areas.

The pharmaceutical sector, which produces very complex molecules with a high added value (polypeptide hormones, vaccines ...), will obviously be one of the first to benefit from the spin-offs of modern biology, particularly from genetic recombination; in France as well as abroad, it is obviously one of the industries most attentive to foreseeable developments. The developing relationship between the Pasteur Institute and the Merieux Institute* must be considered from this standpoint.

Leaders in other industrial sectors, which should be affected in the intermediate or long term, for their part are showing more than moderate enthusiasm. A positive fact should be noted: most of the large industrial groups have started to think about these ideas of the future. At Saint-Gobain-Pont-a-Mousson, for example, it was pointed out that "studies have been in progress for 18 months" and that they are primarily interested in the sectors which the group already dominates technically: development of wood chemistry, problems of energy production or production of plastics from organic raw materials. It is reported that facets of energy (methane fermentation, hydrogen production) would particularly be of interest to groups such as the CGE (General Electricity Company) or Liquid Air.

Several oil companies are also following these developments: for example, it appears that BP [expansion unknown] continues to be attentive, despite the bitter failure--shortly after the 1973 oil crisis--of its project for production of proteins from petroleum. An "active vigil" of the same type is underway at Elf-Erap, according to the group's board of directors, whereas the Pechiney-Ugine-Kuhlmann group is seriously considering investing in basic genetic research.

All of the large companies which we talked to remain very conservative: many have set up study groups, some admit that they have put out "antennae" in the United States or Japan, emphasizing for example that "we will not be able to permit ourselves to rework what the Japanes have already achieved." This conservatism is justified, they explain: research has not yet found its way into their areas; even if "bioindustry" is "easier" than the current chemical industry,** it will continue to be a heavy industry, requiring substantial investments, which means that basic precautions will have to be taken with regard to risk coverage.

"Preparing the Ground"

Finally, particularly in the case of products of mass consumption, the economic environment is still very largely unfavorable to biotechnologies: "Oil is not yet expensive enough for its replacement, as a chemical raw material, by carbonaceous matter derived from the biomass to be profitable in the short term.

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*LE MONDE of 1 November 1979

**For example, fermentation techniques require "mild" conditions of pressure, temperature or degree of acidity.

Especially since European prices of raw materials, like m [illegible] or grain, are much higher than they are at the world level, particularly because of the joint agricultural policy," some people point out. Others stress that it is necessary to wait until researchers learn how to fully develop cellulose or lignite, which represent the main sources of vegetable producti [illegible] f coal, through biological processes.

Several industrial companies have made agreements with public or parapublic laboratories for basic biological research. Some are already even sending trainees, or paying "thesis students," for training in these laboratories in the most modern techniques of genetic engineering. This practice is still largely inadequate, according to Mr Laudat, who states that there are "less than 10" researchers being provided by industry in this case for genetic engineering.

"I cannot spend 1 cent on a new program," the head of a large French industrial group said recently to a researcher. With regard to biotechnologies, such a remark is disturbing if we don't want France "to miss its chance," as was the case with data processing and electronics. Especially since the basic abilities of its research and industry are more than respectable and since its agriculture provides a raw material that should continue to be developed.

Even if many spin-offs described here are not for the immediate future, time is pressing, especially for giving a new impetus to research and for "preparing the ground" in industrial circles. In the United States, several small companies are pinning their ambitions on the scope of the possibilities of the new biology, with one of them even expressing its determination to become the "IBM of biology." Japanese industry, discreet as always, is nevertheless most apt to establish its domination worldwide: about 60 international companies are already working on these "gaps" and are particularly demonstrating undeniable "leadership" in fermentation techniques. And it is estimated that Japan today has more than 4,000 highly qualified microbiologists, with three-fourths working in industry. There are barely more than about 50 in France, whereas Japanese universities grant 300 doctoral degrees every year in these fields and these graduates are starting to have problems finding work ...

Essential Prerequisites

A priority line of action for the government must therefore definitely be to quickly set up suitable systems of training. The establishment of a "bioengineering" trend is also one of the items considered to be a priority in its program by an association of industrialists and researchers concerned with problems of bioindustries, ADEBIO,* recently established.

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*Association pour le Developpement de la Bio-industrie [Association for the Development of Bioindustry], 6 Allee Le Plaisir, La Bergerie, 94460 Valenton

Like the Nora-Minc report on "The Computerization of Society," the Gros-Jacob-Royer report on "Sciences of Life and Society" could have a broad impact on public opinion. At least this is the clearly intended aim of the president of the republic. Biology has not reached the same stage of development as data processing, particularly in terms of its probable effects on daily life. It is also uncertain that, at least with regard to the bioindustrial aspects discussed here, the effects will be quickly noticeable, even after a generation, except through medicine or a modification of production processes, which for the most part remain "opaque" to the consumer and the general public.

It is too early to talk about an "industrial policy of biology," even if certain measures already considered by the government--for example, with regard to the development, for energy or other purposes, of the biomass--clearly call for technologies that can be classified as "biological." But it is time to start thinking on a large scale and far into the future and to quickly get the essential prerequisites together, such as the development of basic and applied research.

From this standpoint, the report to be submitted on Monday to the president of the republic must be a starting point.

11915
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WORLD'S FIRST SOLAR POWER STATION IN CATANIA

Milan L'UNITA in Italian 3 Dec 79 p 7

[Article by Taddeo Canca: "A Thousand Kilowatts of Sun"]

[Text] Adrano (Catania) By the end of 1980, the world's first solar electric power station is to begin operating. Planned 2 years ago, it was financed in 1977 by the European Economic Community and by an Italo-Franco-German consortium. Construction work began a few weeks ago with the installation of the first of 182 solar mirrors which will be part of the complex. If everything goes well, by December of next year the first thousand kilowatts of electric power provided by the sun will be fed into the ENEL [National Electric Power Agency] network. It involves, to be sure, only a drop in the ocean of Italy's energy needs, however it is significant that the possibility of obtaining power from solar rays is being tested.

The Plants

The idea of being able to utilize in some way the heat the sun sends us every day is as old, we can say, as mankind. From the far off and unknown inhabitant of this planet, who by channeling the sun's rays through a glass burned a heap of leaves, up to the present day, man has always dreamed of using the fire from the sun for his own needs. Often this dream became mixed with legend, as in the famous case of Archimedes' solar mirrors, which were to have set fire to the Roman fleet in the port of Siracusa, not far from the location of the world's first solar power station.

Tens of centuries were needed for the perfection, on space vehicles, of instruments capable of capturing the sun's rays and transforming them into energy. It was the space programs that gave a decisive push to solar energy studies. The Adrano plant too availed itself of the experiments and results obtained from space launches. Among others, the computerized system for the constant positioning of the mirrors focusing on the sun will be in operation. The large panels, in fact, are to be regulated by an automated center which will regulate the movements, making adjustments, based on computerized time pieces that have a precision of up to a millionth of a second. It will also be the center which will secure the mirrors when winds exceed 50 kilometers per hour. Following the danger period, the panels will be placed in their exact position, which will take into account the sun's movement during the emergency.

The Italian plants are located on 3.5 hectares, among green orange groves, where the sun almost always shines. The "sun stroke," according to the experts, should average 6 hours per day. The decision to place the power station at this location was made by a European Common Market [EEC] committee charged with searching for new sources of energy in the aftermath of the oil crisis and polemics surrounding nuclear plants. Two other countries, beside Italy, participate in the Adrano program: France and the FRG. Plant costs, at the end of 1980 should not be more than 15 billion lire: half is to be financed by the EEC, and the other half is to be divided equally among the three countries.

The Costs

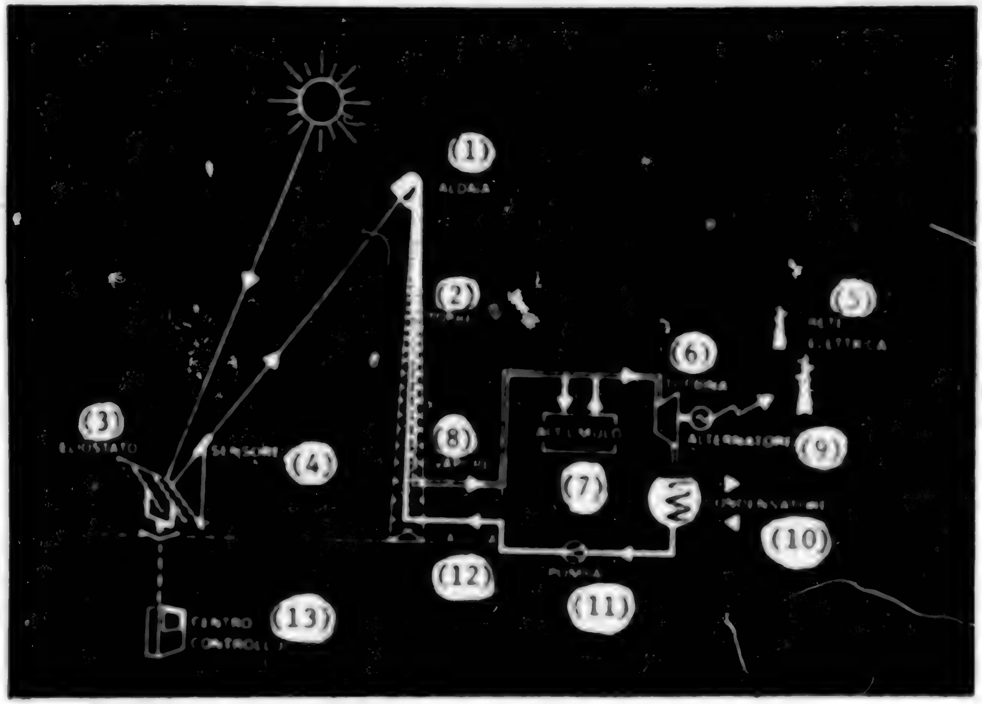
Once completed, the plants will become the property of ENEL, which at this time is shouldering the major burdens of planning and construction. If one realizes that the Adrano plant will produce 1,000 kilowatts and the whole Italian system uses 36,000 megawatts, it is immediately apparent how modest this plant's contribution is. The Adrano plants will be able to furnish electrical energy necessary for the average use of 1,000 families.

The system chosen at Adrano utilizing the sun's rays is known as field and tower of mirrors, perfected for the first time in the world by an Italian scientist, Professor Francia. How does it work? The sun's rays are "captured" by 182 heliostats (mirrors) pointed on one objective: the upper portion of a tower 52 meters tall. Here, a boiler, because of the heat obtained by the concentration of reflected radiation, generates steam which in turn is channeled to a turbine connected to an electric generator.

What possibilities does solar energy offer for the future? On paper, the sun could give us all the energy we need. Reality, however, is totally different. Research and studies tell us that up until now, it has not been possible for solar energy to be a total alternative for something else. The energy the sun provides us free every day can be integrative but not substitutive. Even when another power plant is built next to the one at Adrano and when the roofs of many houses are equipped with solar panels capable of giving us some hot water, we will always need other sources of energy, especially petroleum, in order to obtain electricity.

In the near future, with regard to solar energy, panels mounted on top of buildings found in particularly sunny areas, especially in the Mezzogiorno, will be more common than electrical plants. ENEL is getting ready to furnish electrosolar water heaters to those clients requesting them at particularly favorable payment rates (a few thousand lire monthly added to the light bill).

The obstacle to overcome is that of space coupled with that of cost (which is 20 times greater than the normal expense). To give an example, one must remember that if one wanted to provide Sicily with electric energy using solar power stations, it would be necessary to cover the whole island with solar panels. The low intensity of energy the sun sends us, together with the alternating of day and night and the changes in weather, for the moment make solar energy nonprofitable. Man's old dream has been realized only partially.



Key

1.	Burner	8.	Steam
2.	Tower	9.	Alternator
3.	Heliostat	10.	Condenser
4.	Sensor	11.	Pump
5.	Electric Cables	12.	Water
6.	Turbine	13.	Control Center
7.	Accumulation		

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CSO: 3102

ITALY

OBSTACLES TO DEVELOPMENT OF PASSIVE SOLAR SYSTEMS

Rome FONTI DI ENERGIA ALTERNATIVE in Italian Jul-Aug 79 pp 54-59

[Article by Aldo Fanchiotti, University Institute of Architecture of Venice: "Energy Savings--Problems Connected with Large-Scale Diffusion of Passive Solar Systems"]

[Text] 1. Introduction

The term "passive solar systems," for heating of buildings, comprises a complex and differentiated range of technologies, both proposed and in practice, related to the construction of buildings that on the one hand have energy-conservation properties, and on the other, devices that make it possible to collect, store and transfer incident solar radiation to the spaces to be heated without the intervention of mechanical means such as pumps, fans, etc.

The diffusion of these techniques, which the experience acquired in other countries permits one to judge as being among the most advanced, both technically and economically, is encountering obstacles and difficulties of different kinds and importance.

As with all technological innovations, there are resistances owing to the rigidity both of the production system and of the market, in addition to the difficulties in the energy sector itself, in which the competition of the traditional sources against the new sources is very aggressive. Finally, there are obstacles connected with the particular sector of activity--building--in which these techniques should have their effect; the building sector has particular characteristics that cannot be ignored. In what follows, an initial examination of these difficulties (the obstacles) will be attempted.

Secondly, an attempt will be made to define a list of activities (the actions) that should, with varying effectiveness, lead to overcoming the difficulties.

Finally, the social organisms (the protagonists) which, at the various levels, are called on to carry out the activities--that is, to take on responsibility for the diffusion of these techniques--will be listed.

An attempt to specify precise elements and the role that they play is necessary and urgent, taking into consideration the seriousness of the energy crisis that confronts us, the importance of the domestic-consumption sector in the national energy balance-sheet, and the maturity and reliability of these techniques.

2. The Obstacles

They can be grouped in four categories: obstacles of a technical nature: economic obstacles; obstacles connected with the difficulty of getting the introduction of a new technology off the ground; and obstacles related to standards and institutions.

2.1 Technical Obstacles

(a) Lack of Products on the Market

With the lack in Italy of direct experience of building passive solar buildings--in contrast to what is already happening in other countries (United States, France)--a process of design, development, production and marketing of materials, products, components, with known and certified performance characteristics, for a new type of construction practice, has not yet been set in motion.

(b) Lack of Design Tools

For the reasons already noted, there is also a lack of proven design tools that would make it possible to design the dimensions of the various parts of a building by simple calculation procedures, or by rules that are now a common patrimony. In brief, a manual for design that is correct in energy terms is lacking.

(c) Lack of Experimental Data

Since no passive buildings, or almost none, have been built in our country, on-site data on the performance characteristics of the various techniques are not available. But many data from abroad--especially the United States--are available; however, direct transposition of them to the Italian situation is difficult, both because of the different climatic conditions and because of the differences of construction practice and building types between the two countries.

(d) Lack of Climate Data

Knowledge of the climate of the localities where it is planned to build is a fundamental requirement for correct design.

In Italy, the network for recording climate data is inadequate, especially as regards solar radiation; the data recorded are not sufficient, and elaboration of them is even more limited.

2.2 Economic Obstacles

(a) Initial Cost

A passive building generally has a higher construction cost than a conventional building. However, the savings on operating costs almost always justify the investment, even at the microeconomic level.

Nevertheless, higher initial cost constitutes an impediment in any case.

(b) Resistance by Existing Interests

It is certainly difficult to evaluate the importance of the difficulties of this type, but it is undeniable that they exist. Designing and building in new ways, making far less use than at present of traditional energy installations and sources, constitutes a threat to professional fields, skills, production practices, divisions of labor, profits, distribution networks, and well-established balances. All this necessarily engenders strong resistance to the change on the part of groups or individuals who feel their own interests menaced.

(c) Uncertainty about Criterion of Evaluation

The present author has had opportunity to discuss this problem in detail on another occasion [2]. In substance, it involves the difficulty of defining, clearly and unequivolcally, a criterion by which to evaluate the effectiveness of various approaches, especially when passive techniques are being adopted. This uncertainty involves a difficulty of judgment, and therefore of decision.

(d) Price Structure of Energy Sources

The introduction of conversion techniques using alternative energy sources, as in this case, must be measured against the competition represented by the conventional energy sources.

The economic aspects of this competition are determined to a high degree by the present price and rate structure of such sources and their future evolution. As regards the present, it cannot be forgotten that the unit cost of conventional energy is the result of a complex set of political factors, in the first place, and also of technical and production factors, supply factors, historical factors. As regards this last-named aspect, one should think about the effect on the present cost of a nuclear kWh of the mass of doubtful investments made in that sector by the governments of various countries in the course of the last 40 years. And as regards the evolution of such costs, almost no one dares to make forecasts for more than a year into the future.

Under these conditions, and as mentioned in point (a) above, there is a considerable hesitation on the part of elements of the economy to go ahead with projects whose rationale is based on probable but not quantifiable future savings, spread out over quite a few years.

2.3 Obstacles to Startup

(a) Insufficient Awareness

Despite an undeniable increase in interest and circulation of information about the possibilities of alternative energy sources, awareness of what they can give, and even more, of the steps to be taken in order for this to happen, is still very insufficient.

This is true at all levels: from the level of the public at large to the level of the experts in undustrial fields, and finally, the level where the big decisions are made.

This situation is especially serious as regards the passive solar techniques, which do not enjoy anything like the familiarity--albeit a superficial one--now reached by the image of the flat solar collector on the roof of a building.

(b) Lack of Experienced Designers

The problem of getting started clearly involves a vicious circle: there is no construction because there is no one who knows how to design, and there is no one to design because there has never been any construction.

(c) Inertia of the Construction Sector

As mentioned in the introduction, one type of problem common to all innovations consists in passive resistance to change, even if it does not involve the economic interests of the protagonists, and at times, even if such resistance runs against them. This is particularly true in the construction sector, which evolves very slowly and in a very unhomogeneous manner.

2.4 Institutional Obstacles

(a) Lack of Legislation

The existing legislation relating to construction and energy is largely inadequate to cope with the problems related to the use of passive techniques. Law 373, for example--which is analyzed better in [2]--being based solely on the heat-loss aspect and totally ignoring the aspect of solar-energy gains, can actually penalize the use of passive approaches, imposing unjustified increases in insulation on it to compensate for greater losses, which appear so only if one forgets to compute the positive contribution, the gain, from the passive components. Even the bill on the use of alternative sources, in its draft as known to date, ignores the problem of the passive solar techniques, limiting its attention to incentives to the use of active systems.

(b) Construction Regulations

Here too, the question is totally ignored, when obstacles are not actually put in its way, on the basis of standards on glazed surface areas, for example.

(c) Regulatory Plans

The problem of sunshine rights is ignored, so that zoning and the infrastructures often impose limitations that make the adoption of passive approaches very problematic.

3. The Actions

The following list does not follow any particular order, in view of the fact that in many cases, the same action requires intervention by several protagonists and is useful for coping with several obstacles.

(a) Product Development

It is possible and necessary to start up and stimulate a process that leads to finding a place in the market for reliable materials and components.

(b) Development of Tools for Design

The objective of a design manual should be pursued decisively, with collection, organization and adaptation of all available information.

(c) Program of Demonstration Construction

It is surely possible to construct buildings that are not simply experimental but can be put to real use and are based on design approaches already sufficiently tested that their reliability is assured.

The effects of such a program would be twofold: on the one hand, demonstration of the concrete feasibility of these approaches; and on the other hand, the acquisition and digestion of effective experience in design and construction

(d) Building Instrumentation

The passive buildings that are being constructed (the first and most significant) must be instrumented in such a way as to permit the collection of operating data for the purpose of refining the design tools on the basis of experience.

(e) Recording of Climate Data

The network for recording data on climate and solar radiation must be improved and the data must be collected in a more coherent manner (time data, direct-radiation and diffuse-radiation data). At the same time, digital methods for processing the existing data must be developed.

(f) Economic Incentives

One might suggest various types of economic incentives on the part of the state aimed at encouraging the adoption of passive approaches in private construction.

Typical instruments are the allowance of tax deduction of the major part of the expense related to application of these techniques, and the granting of loans at reduced rates of interest. The extent of the financial effort required must obviously be evaluated and time-scheduled on the basis of cost analysis, the impact on the energy balance-sheet, and the progress of market penetration.

(g) Criteria for Evaluation

It is indispensable for agreement to be reached on a criterion for evaluation of the performance characteristics of passive systems that is simple to apply and that permits comparison of approaches even if very different from one another [2].

(h) Prices and Rates of Energy Sources

As emphasized in the section on obstacles, the structure of prices and rates must be revised, and reasonable margins of future variation must be indicated, so as to make as clear and predictable as possible the framework within which the various technologies must find a role.

(i) Informing the Public

The public's idea of alternative energy sources is the one transmitted by the mass media, with the schools still largely out of the picture as a means of education and information in this sector.

This idea depicts solar energy, for example, either as a bizarre and marginal curiosity or as the answer to mankind's energy problems--but in the year 2050 and after. In both cases, the message is that nothing significant can be done in the near future.

This message should be changed, because it is false. The passive solar technologies are available now, and in a very few years can have a considerable effect on national energy consumption if a choice in this direction is made with conviction. The public should be informed accurately about these techniques, and about what can be done with them right away.

(l) Education of New Designers

The curriculum of study of architects and engineers should provide adequate preparation in the field of energy-aware design.

To this end, the energy questions should not only be taken up, as they now are, within the compass of the scientific disciplines--though even this does not always happen--but should also be included as stimulus and as an element of practical work in the interdisciplinary and city-planning disciplines.

(m) Informing/Training Designers

Courses, seminars, conferences can be tools for furnishing the designers already working in the field the information necessary for keeping their professional qualifications up to date. Forms of official recognition (certificates?) of the professional updating work done can be suggested.

(n) Informing the Construction Professionals

In addition to the designers, all the operators in the construction sector, at the various levels of interest and specialties, should be informed about the possibilities offered by the new techniques: builders, construction technicians, construction workers, as well as financiers in the construction field, officials of public agencies, and so on.

(o) Informing Local Administrations

The personnel of the technical departments in local administrations (communes and regions) who are responsible for issuing permits and compiling regulations and plans should receive special attention and information, so as to be able to evaluate the application of passive approaches and also to stimulate and encourage them.

(p) National Energy Plan

If the various actions proposed here were to be carried out in a precise chronological sequence, the drawing-up of a new national energy plan would be one of the first items.

The need, already referred to, for demonstration programs, rate regulation, economic incentives, and so forth, can be given priority definition and commitment only within the framework of a plan that represents a coherent set of choices, well-founded from the technical, economic and political points of view.

(q) Public Construction Programs

With its direct support and its subsidies, the state's activity in the construction sector is of such dimensions that it represents a field for priority action. The future programs, starting now with the current 10-year housing plan, should provide for increasing proportions of solar construction, in coordination with the information that will gradually become available from the demonstration program and the research activity.

(r) Federal Laws

The laws that regulate activity in the construction sector should take account of the energy aspects, and should in particular encourage the construction of low-energy-consumption buildings, both by imposing limits and by instituting incentives.

(s) New Criteria for Regulatory Plans and Construction Regulations

All the regulatory plans and construction regulations should be reviewed in the light of the new energy problems and the resources available locally, so as to permit--or better, stimulate--innovative approaches.

(t) Initiatives "from the Bottom"

Initiatives taken by citizens and associations, or individual local entities, without drawing up programs beforehand, without permits, financing, government blessing, should not be undervalued. In the United States, all the research in the passive-systems sector, in its initial stages, was done through the efforts of individuals or small groups.

Do-it-yourself construction, and the individual and community levels, is a phenomenon of vast proportions in the United States, and there is nothing to prevent something similar from happening in Italy (indeed, it is to be hoped for).

(u) Plans for Production Changeover

If applied on a large scale, as is necessary, the changes brought about by the new technologies will create the need for profound transformations in the entire sector, with the consequent necessity of preparing plans for production changeover--plans defining the investment levels, the employment levels, territorial distribution, production techniques, organization of labor, and so on.

4. The Protagonists

The actions to be carried out require actors, whom we shall individuate.

(a) Parties - Parliament

In view of the strong political connotation of choices in the energy field, the role of Parliament and of the political parties is central. The actions to be carried out concern both legislative activity--which, as has been seen, can have a decisive effect on the development of the new technologies --and the plan for formation of the program and of the government, which has responsibilities in many of the actions identified.

(b) Ministry of Industry

Responsibility for the country's energy supply falls to this ministry, which is therefore a direct protagonist in many of the actions listed above. A particular task of ths ministry is the definition of the National Energy Plan, to be submitted to Parliament for ratification.

(c) Ministry of Public Works

In view of the important role that the program of public intervention in the construction sector can play, the action of the Ministry of Public Works, and especially of the Residential Housing Committee in giving directives to the Public Housing Institute, is of absolute importance.

(d) Ministry of Public Instruction

The hoped-for modifications of the officially stated goals of education, and more generally, the ongoing-education function that the Ministry of Public Instruction must carry out, represent another essential element for the diffusion of information and training of personnel qualified to fill the various roles necessary.

(e) Other Ministries

Many other ministries must be active protagonists, at various levels, in the work of diffusion of the passive techniques. One thinks of the financial aspects, the participation of industrial firms, exchange of information with foreign countries, research and development, as well as the fact that every ministry has a more or less large number of buildings to operate and renovate.

(f) State Agencies

The big state agencies (ENI [National Hydrocarbons Agency], ENEL [National Electric Power Agency], IRI [Industrial Reconstruction Institute]) have great possibilities and great responsibilities in the entire energy sector, and therefore in the field of heating of buildings.

These agencies too have buildings to manage, and are involved in various ways in the sector's production activities. Their field of activity covers all aspects of the problem, from basic research to demonstration projects, obviously with limitations and different emphases and responsibilities, but always in a way that cannot be overlooked.

(g) CNEN [National Nuclear Energy Commission]

The CNEN may be assigned the task of coordinating development and demonstration activities in the field of alternative energy sources. A considerable part of this activity will have to be the definition and implementation of a demonstration program in the sector in question. The collection, processing and distribution of data would also be the responsibility of the CNEN, which should therefore be involved in many of the actions planned.

(h) CNR [National Research Council]

Within the framework of the activity of the Purpose-Directed Energy Project of the National Research Council, in the subprojects on Solar Energy and Energy-Saving in Buildings, research of various types on the passive systems is already in progress. Whatever form it may take in the future, it is indispensable for intense research activity to continue and indeed to be developed strongly, this being an essential condition for development of techniques, design procedures and products.

(i) The Local Administrations

The regions and communes have a vast body of competencies and are directly responsible for drafting regulatory plans and construction regulations, and are in a key position to oversee and stimulate the proper diffusion of new construction practices.

(l) Public Housing Institutes

The importance of the attitude of the various IACP's [Public Housing Institutes] in achieving a coherent modification of building methods hardly needs to be stressed.

(m) Schools, Universities

The directives of the Ministry of Public Instruction constitute action in the schools and the universities, which have to commit themselves to a more flexible relationship with field, so as to furnish various places and opportunities for training and in return receive stimuli for their own research activities.

(n) Industry

The nation's industry must commit itself to development of materials and components that meet the new requirements, and to do so, it must, as mentioned, make a profound changeover effort.

(o) Cooperatives

The network of cooperatives, with their planning, production and purchasing, is very vast and well-established in our country, especially in the construction sector, where these organisms, which are already showing sensitive attention to the energy problem, can play an important role.

(p) Builders

Obviously, the role of the private building contractors is also very important, even though this sector will predictably be the one that most expects assured profitability and public acceptance before it starts down unknown roads.

(q) Designers

It should not be thought that the designers' only task is to be capable of using the new techniques well, in response to demand in the form of commissions.

The designers must actually play an important role in stimulus and innovation.

(r) Trade Unions

The considerable implications for employment and the need to prepare plans for restructuring mean that the participation of the workers and their trade-union organizations in defining an energy policy and articulating it in the various areas of production is essential.

(s) Professional Associations

The professional associations can help stimulate interest and distribute information about the new techniques among their members.

(t) Financing Agencies

Loans and investments are controlled by the Institutes of Credit and the various financing agencies.

Therefore it is necessary for the decisions made by these bodies to be coherent with the guidelines and efforts defined in all the other areas, so that bottlenecks are avoided at the crucial moment--the construction phase--and so that incentive instruments, such as reduced-rate loans, can even be arranged ahead of time.

(u) Press and Communications Media

The crucial role played by the mass media in forming the public's idea of the energy problems and the possible solutions is obvious.

An information effort by these media is an irreplaceable tool for a rapid spread of the awareness which, as mentioned above, is to be hoped for.

(v) Associations

There is a wide field open for spontaneous initiatives by citizens' groups or associations, both outside the government programs and through a dialectic with them that commands recognition. Innumerable initiatives by such organisms can be imagined and are desirable.

(z) Citizens, Parties

In point (a) above, we referred to the role of the political parties in their function as legislators and with regard to their responsibility for forming a political program or a government that carries it out.

Here we refer to the parties in their role of expressing the political will of the citizenry--that is, their function as coordinators and organizers of the desires and interests of the various sectors of society. In this sense, organized demand by social forces and individuals for a new energy policy is probably the most effective instrument for getting started and making sure that appropriate energy technologies, such as the passive solar techniques, are adopted on a large scale.

5. Conclusions

The lists presented of obstacles, actions and protagonists constitute only an initial and certainly incomplete outline of a labor of comprehension and definition that is very important.

The various points briefly commented on must be organized into a "matrix" that relates each obstacle to the actions that must be carried out to overcome it and the protagonists who must do so.

The next development will be to define, on the basis of the matrix, the relative effectiveness of the various actions and the most productive division of roles among the various protagonists, and on the basis of these elements, to solicit the participation of all parties involved.

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11267
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ITALY

USE OF HYDROGEN TO STORE, TRANSMIT POWER

Rome FONTI DI ENERGIA ALTERNATIVE in Italian No 2, Mar-Apr 79 pp 14-21

[Article by Paolo Boccanera, Andrea Moriconi and Antonio Naviglio, members of the Nuclear Plant Laboratory, College of Engineering, University of Rome: "Possible Uses of Hydrogen as an Energy Transportation and Storage Component in a Total Energy System"]

[Text] Introduction

An article published in a previous issue of FONTI DI ENERGIA ALTERNATIVE* discussed the fundamental problem of energy storage and brought in the concept of a hydrogen economy as a possible solution to that problem .

The present article discusses a mode of using hydrogen specifically as an energy storage component. It analyzes a system in which electrical energy taken from the power distribution network during low-demand periods is used to produce H_2 by electrolysis. The hydrogen energy potential produced is stored by absorption of the gas in iron-titanium hydride beds, from which it is recovered (during energy peak demand periods) in the form of electrical energy through hydrogen-fueled fuel cells, that is, electric cells that use as a fuel the hydrogen previously absorbed by the FeTi hydride and subsequently dissociated from it through simple heating.

The thermal energy developed during the formation of the metallic hydride and that which must be supplied to release hydrogen are respectively removed and transferred by a thermal-carrier liquid circulating in pipes inside the vessels containing the hydride.

The proposed plant systems and their economic evaluations are based on the chemical properties of iron-titanium, as determined by laboratory tests[5] carried out on small-scale test absorption-beds, and on engineering studies

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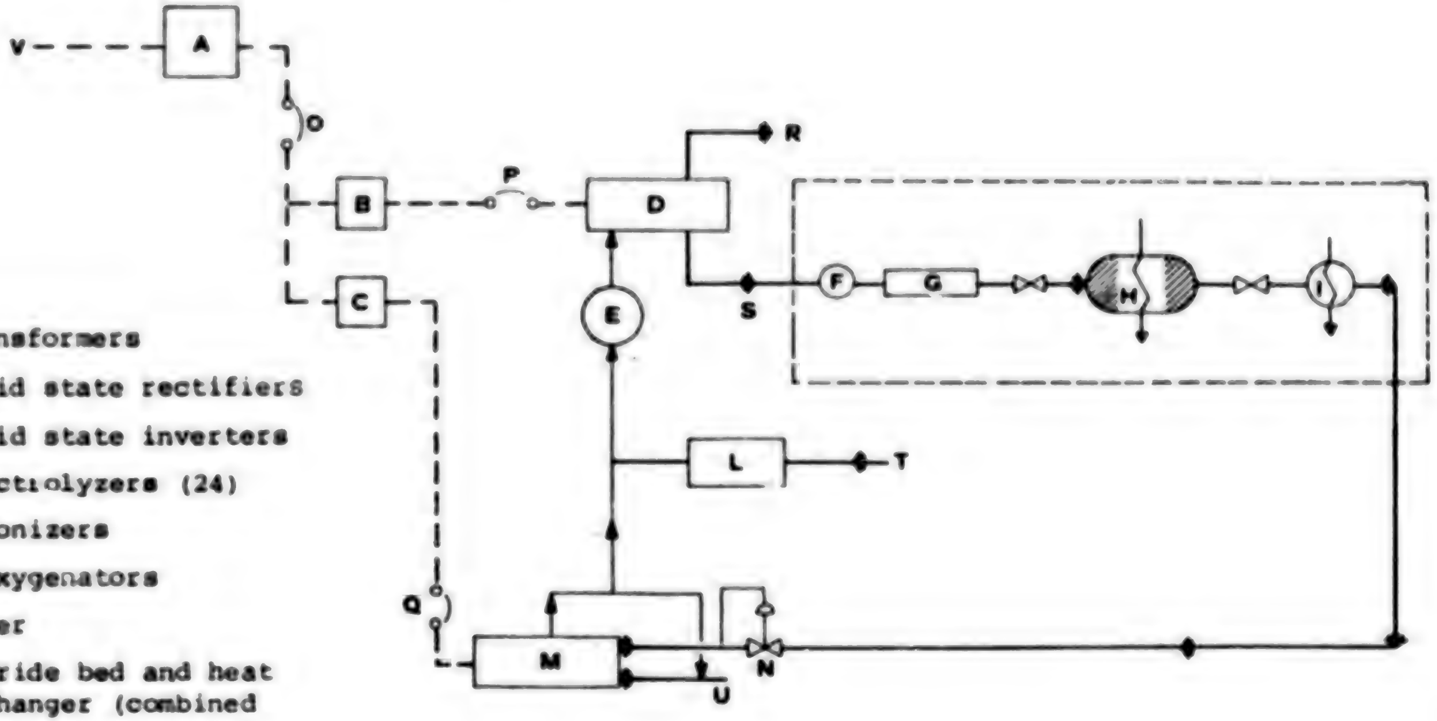
* See FONTI DI ENERGIA ALTERNATIVE No 5, Sept-Oct 1978.



Key:

A. Transformers

B. Solid state rectifiers

C. Solid state inverters

D. Electrolyzers (24)

E. Deionizers

F. Deoxygenators

G. Drier

H. Hydride bed and heat exchanger (combined unit)

I. Heater

L. H_2O treatment

M. Fuel-cell batteries

N. Pressure regulator valve

O. Switch

P. Switch closed during hydrogenation phase

Q. Switch closed during dehydrogenation phase

R. Oxygen discharge into atmosphere

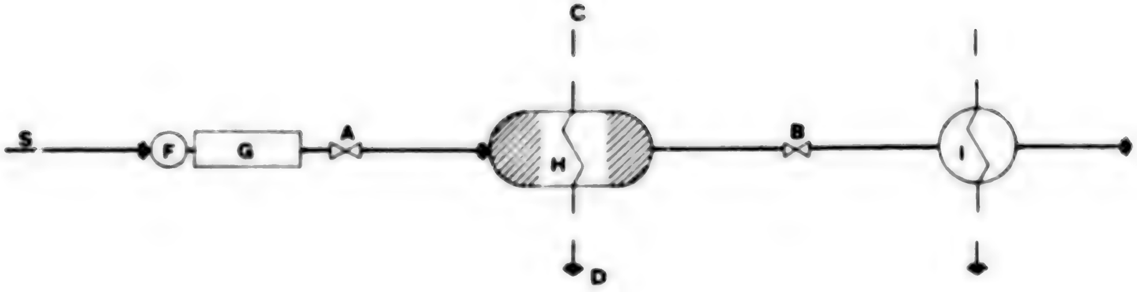
S. Hydrogen output from electrolyzers

T. H_2O reintegration

U. Air intake

V. 3-phase alternating current line

Fig 1 - Processing scheme for a metallic-hydride energy storage power plant.



Key:

A. Valve open during hydrogenation phase

B. Valve closed during hydrogenation phase

C. Cooling water intake (30° C)

D. Cooling water discharge (43° C)

F. Deoxygenator ($O_2 < 12$ ppm by volume)

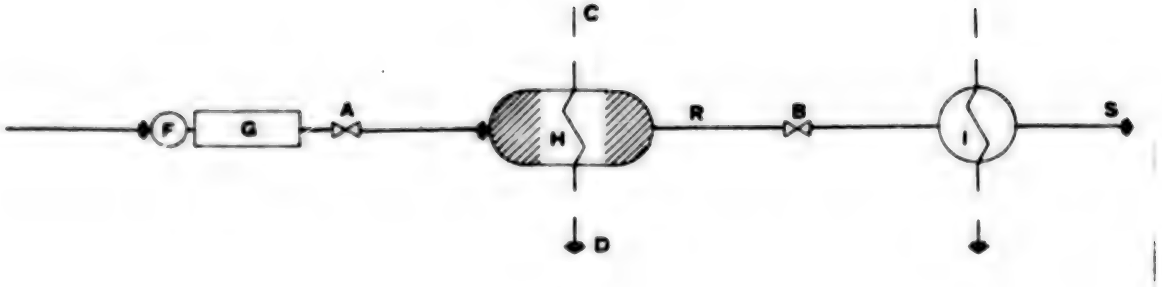
G. Drier (dew point: - 60° C)

H. Combined unit: hydride bed and heat exchanger (hydrogenation from $FeTiH_{0.2}$ to $FeTiH_{1.4}$)

I. Heater

S. Hydrogen flow from electrolyzers (1,270 kg/hr, 32° C, 31 atm)

Fig 2 - Processing scheme for hydrogenation section of metallic-hydride energy storage plant.



Key:

A. Valve closed during dehydrogenation phase

B. Valve open during dehydrogenation phase

C. Hot water (161° C, 8.8 atm)

D. Water (150° C, 8.6 atm) flow from exchanger (thermal load of unit = 4.76 x 10^6 kcal/hr)

F. Deoxygenator

G. Drier

H. Combined unit: hydride bed/heat exchanger

I. Heat exchanger (0.375 x 10^6 kcal/hr)

R. Hydrogen flow from hydride bed (equilibrium temperature for dissociation of hydride: 45-71° C) (pressure: 20.5 atm)

S. Hydrogen flow to fuel cells (157° C, 20 atm)

Fig 3 - Processing scheme for dehydrogenation section of a metallic-hydride energy atorage plant.

carried out by Brookhaven National Laboratory (BNL) and its subcontractors (Burns & Roe, and others). The characteristics of the plant based on current technology and those based on adoption of an advanced technology are treated separately.

Figure 1 shows the flow diagram of the entire process.

During the hydrogen production and storage phase, 3-phase alternating current at high voltage (derived from the distribution network) is transformed and rectified to direct current by means of solid state rectifiers.

The direct current is used to supply a water electrolyzing plant capable of producing (at maximum capacity) around 1,470 kilograms per hour of hydrogen (11,662 kg/hr of oxygen). Hydrogen production under normal operating conditions (continuous operation) is approximately 1,265 kg/hr (9,945 kg/hr of oxygen).

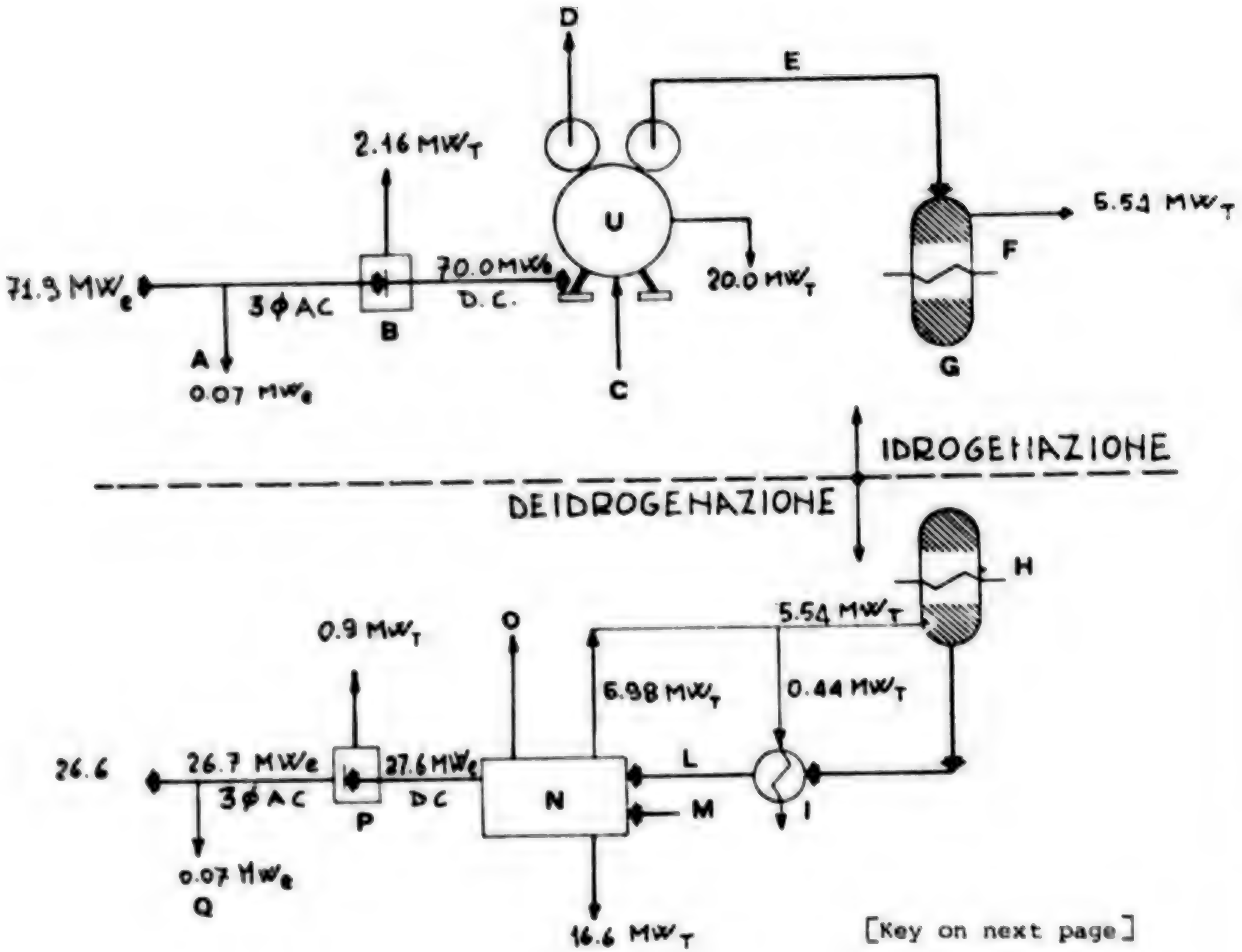
Whereas the oxygen can be released into the atmosphere, the hydrogen is cooled, passed through a deoxygenator, then conveyed to a drier where, by removal of the residual water vapor, its dew point is brought down below - 60° C.

The dehumidified gas is finally conveyed to the combined hydride bed and heat exchanger unit, where it is absorbed and stored.

Operating temperatures and pressures during the storage action phase, and other parameters that characterize the process, are shown in Figure 2. During this phase the valve located downstream from the absorption beds is closed and the cooling water is made to circulate through the pipes that traverse the beds, to remove the heat generated by the absorption reaction of the hydrogen on the metal as well as the sensible heat of the hydrogen. Knowing the rate of storage (1,265 kg/hr) of the H_2 and the heat per unit mass (3,763 kcal/kg) to be removed, the thermal power to be removed can be determined.

The parametric values characterizing the discharge phase(emission of the gas from the storage unit) are shown in Figure 3. During this phase, the on-off valve located between the drier and the absorption beds is closed, whereas the valve leading to the fuel-cell battery is held open.

Hot water resulting from the cooling of the fuel cells and circulating through the same exchanger pipes used in the storage phase supplies the heat needed to release free hydrogen and heat it to the necessary temperature. Since the sensible heat is negligible with respect to the required heat for dehydrogenation, the thermal power can be calculated from the quantity of hydrogen produced per unit time (1,265 kg/hr) and the energy needed to free unit mass (3,763 kcal/kg). The primary subsystems comprising a 26-MW(E) [megawatts (electric)] plant utilizing this process include



[Key on next page]

Fig 4 - Metallic hydride plant for energy storage.

Key to Figure 4 [preceding page]:

- A. Ancillary equipment
- B. Solid state rectifiers
- C. Water (13,150 liters/hr)
- D. Oxygen (10,000 kg/hr)
- E. Hydrogen (1,270 kg/hr)
- F. Cooling water
- G. Combined unit: hydride bed/heat exchanger
- H. Hot water from fuel cells
- I. Hot water for fuel cells
- L. Hydrogen (1,270 kg/hr)
- M. Air (stoichiometric quantity: 43,550 kg/hr)
- N. Fuel-cell batteries (24)
- O. Water (11,350 liters/hr)
- P. Inverters
- Q. Ancillary equipment
- U. Electrolyzers (24)

a battery of 24 alkali-electrolyte (KOH) water-electrolyzer modules capable of producing hydrogen at pressures up to 30 atmospheres, 10 Fe-Ti hydride exchanger-beds for hydrogen storage, and 24 acid-electrolyte (phosphoric acid) fuel cell modular units.

Auxiliary electrical components include the current rectifier for the direct-current supply to the electrolyzers, an inverter and transformers for converting the 500-volt direct-current output from the fuel cells into 3-phase alternating current at 6.9 kv.

The cooling and heating systems include--in addition to the components mentioned above--water-cooling towers, an intermediate cooling system for the electrolyzers (complete with heat exchanger units), and lastly, a heating system for the hydride beds capable of taking heat from the fuel cells.

Plant Characteristics

Figure 4 shows the characteristics of the plant under rated operating conditions.

During the storage action phase, 72.5 MW(E) of power are transmitted to the rectifiers, which dissipate approximately 2.16 MW(Th) [megawatts (thermal)] of heat; thus, approximately 70 MW(E) (direct current) are consumed in the electrolysis process. The electrolyzers are capable of producing 1,265 kg/hr of hydrogen, with an efficiency of around 72 percent; hence, 20 MW are dissipated in heat and released, directly or indirectly, through the cooling water, to the atmosphere.

Assuming, as appears likely, that the hydrogen produced will be stored continuously and without losses as hydride, the eventual power losses during the storage phase, in the form of energy freed during the hydrogenation process, will be 5.54 MW (equivalent to 3,763 kcal/kg H_2). The hydrogen's chemical energy will therefore be stored at the rate of 50.1 MW, and the phase efficiency, defined as the ratio between rate of chemical energy storage of the H_2 and total power demand of the plant, will be 69 percent.

During the hydride dissociation process, the power required to desorb 1,265 kh/hr of hydrogen (5.54 MW) is supplied from the heat emitted by the fuel cells, whose conversion efficiency is assumed to be 55 percent. Additional thermal power in the amount of 0.44 MW is supplied by the same source to preheat the hydrogen to the optimum temperature for the combustion itself.

Thus, an input power of 50.1 MW into the fuel cells yields an electric power output of 27.6 MW(E) and a thermal power dissipation of 22.6 MW(Th); a portion of the latter is recovered and the rest is discharged directly into the atmosphere. Taking into further account the efficiency of the inverters (97 percent) and the need to supply other plant requirements

(0.7 MW), the net power output (3-phase alternating current) is 26.0 MW(E). The coversion phase efficiency, defined as the ratio between net power output and rate of available chemical energy, is therefore 52 percent.

The overall efficiency of the plant (power output/power input) is 36 percent.

Costs

Construction of a plant of the type described, using components that are currently available on the market, should represent a capital cost (based on 1975 prices) of approximately 150,000 lire per kilowatt (electric), for a 10-hour charge and discharge cycle[1].

Whereas this cost evaluation has been based on the current state of the art and therefore represents the reference cost in an economic comparison with other energy storage solutions, a reasonable forecast can also be made of the further development possibilities of the technology, once adopted (based on the status of current related research programs), and of the cost reductions that will probably result therefrom.

A higher efficiency yield from the electrolyzers, obtainable at higher operating temperatures, should result in an overall efficiency of 50 percent and a consequent capital cost reduction of approximately 55,000 lire/kW(E).

Use of this new technology appears possible starting in 1980.

Table 1 shows the cost distribution relative to a plant of the type desribed and based on use of an advanced technology. Table 2 compares these costs in terms of percentages of the total cost for a plant based on advanced technology and one based on present technology.

The unit cost (lire per kW) below which installation of an electrical energy storage system as a component of a national energy system becomes economical is a multivariate function, some of the variables of which are difficultly controllable.

Specifically, two of these variables in any case (currently) play a predominant part in determining the curve of these costs:

--overall conversion efficiency of the plant;

--load factor.

Figures 5A and 5B show the maximum viable cost curves as a function of overall storage system efficiency and of consumption factor for a given fuel-oil unit cost. Although curves of the type derived in Figures 5A and

Table 1

Recapitulation of estimated costs for equipping an advanced-technology (1980), 26-MW(E), metallic-hydride storage plant, based on a 10-hour charge/discharge cycle:

	(in 1975 dollars) $/kW-hr(E) (*)	$/kW(E) (*)
1. Electrolyzers for H_2O, including ancillary equipment	15	140
2. Hydride storage beds/heat exchangers	11	110
3. Iron-titanium hydride powders	6	60
4. Fuel-cell batteries, including conversion and inversion equipment	15	150
5. Piping, valves, monitoring and instrumentation apparatus	10	100
6. Accessory electrical equipment	7	70
7. Structures and foundations	3	30
Total plant cost	66	660

* Based on electrical network of the plant.

Table 2

Cost distribution comparison between current situation and an advanced-technology (1980), 26-MW(E), metallic-hydride storage plant, based on a 10-hour charge/discharge cycle:

	plant	
	current (percent)	advanced (percent)
1. Electrolyzers for H_2O, including ancillary equipment	36	21
2. Hydride storage beds/heat exchangers, including ancillary equipment for purifying hydrogen	10	17
3. Iron-titanium hydride powders	11	8
4. Fuel-cell batteries, including conversion and inversion equipment	12	23
5. Piping, valves, monitoring and instrumentation apparatus	12	15
6. Accessory electrical equipment	11	11
7. Structures and foundations	8	5

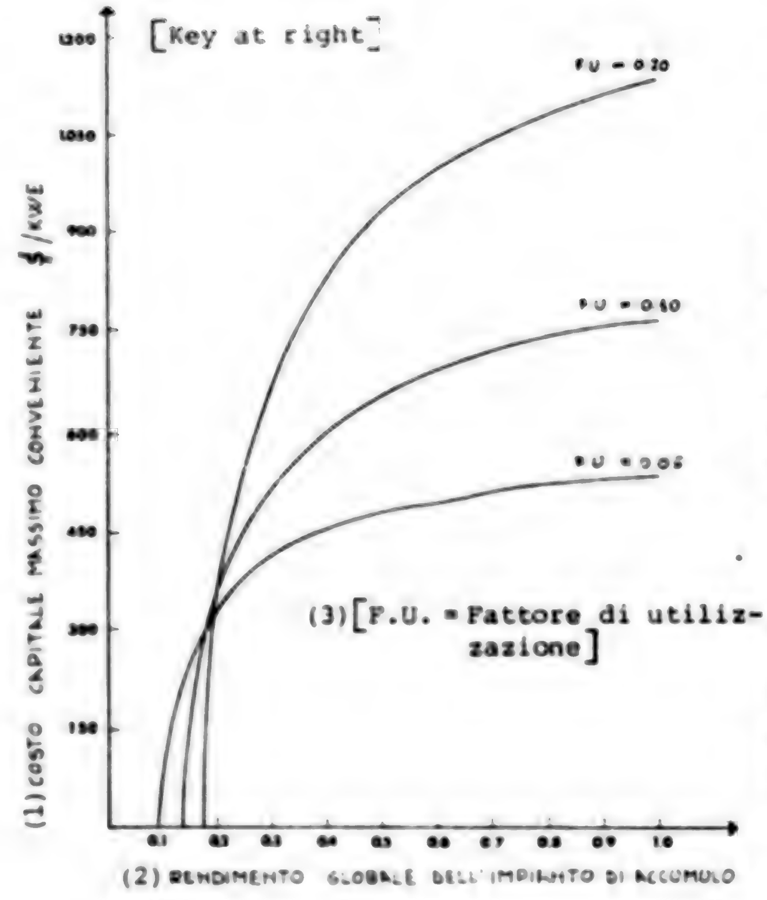


Fig 5A - Maximum viable capital cost of a storage plant as a function of its overall efficiency. (Nominal peak load distribution. Fuel oil price: $2.60/250,000 kcal.)

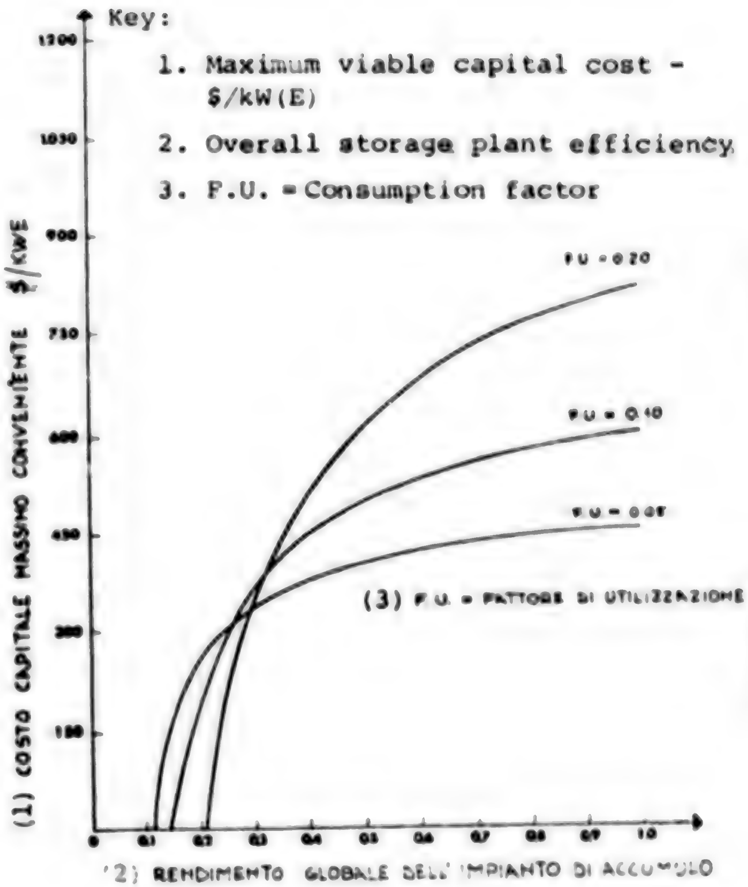


Fig 5B - Maximum viable capital cost of a storage plant as a function of its overall efficiency. (Nominal peak load distribution. Fuel oil price: $3.90/250,000 kcal.)

5B have no practical value, they nevertheless show that increases in efficiency and load factor are accompanied by increased viability, and particularly that above a certain value of efficiency (50 percent) the load factor assumes predominant importance.

Dual Mode Utilization

Evaluations based on these data have led to the choice of the "dual mode" as the optimum method of utilizing an H_2 energy-storage plant. The hydrogen, which also in this case is produced by electolysis and stored during off-peak periods, can be introduced into a conventional natural gas distribution network, or used to generate electrical energy, during peak periods.

In the first case (introduction into the natural gas distribution system) as well as the second (generation of electrical energy) the hydrogen-producing equipment is the same; and an additional advantage can be gained using fuel cells for the conversion of chemical energy into electrical energy; such fuel cells can in fact be fueled by hydrogen derived from fossil-fuel reforming, or by electrolytically-produced hydrogen, or by suitably treated fuel oil. This mode substantially augments the load factors of each of the critical components, which are the battery of electrolyzers and the battery of fuel cells.

a) Introduction Into Natural Gas Networks

The decision to introduce electrolytic hydrogen into a natural gas distribution network can have as its object the integration of the natural gas supply (which is shrinking) or the augmentation of the load factor in power plants that provide an intermediate or basic service (usable for hydrogen production).

From the standpoint of feasibility, several solutions are available that are more or less suitable depending upon the characteristics of the energy production and distribution system being considered and whose economic viabilities are linked to factors common to all, such as: a gradually shrinking availability of natural gas, availability of off-peak electric power, technological improvements and market availability of electrolyzers, and lastly, technological problems of hydrogen-induced embrittlement (compatibility of materials).

A Brookhaven National Laboratory study estimates the cost of producing electrolytic hydrogen in the United States in 1985 will be of the order of 3,000-4,000 lire/10^6 Btu.*

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* This study was based on data relative to the shortage of natural gas in relation to demand,[2] data relative to the availability of off-peak power expressed as a percentage of total electric power production

That figure compares favorably with current costs of natural gas (which for the same regions varied between 1,000 and 1,300 lire/250,000 kcal in June 1975), and with projected costs of natural gas derived from coal (which are within the range of 2,500-3,500 lire/250,000 kcal).

Such comparison indicates the possible viability of introducing electrolytic hydrogen into the existing natural gas network--at least in those regions having the availability of nuclear energy at low cost--above all if it is done in concentrations not requiring changes in the transmitting and consumption equipment already in place.

b) Electric Energy for Peak Periods

For the production of electric energy from hydrogen, two essential equipments are required: fuel cells and electrolyzers.

A fuel cell can burn hydrogen which can be obtained (for this purpose) by conversion (into H_2) of a fuel of organic origin through reforming processes, or which can be produced (at a high grade of purity) directly by other means (for example: by electrolytic processes coupled to electric power generating plants, or by coal gassification processes capable of producing hydrogen as a primary or secondary product).

Fuel-cell batteries can be used either to cover medium electric power loads, or to cover peak loads by suitably optimizing the feeding, that is, using the fossil-fuel system during virtually constant load periods and cutting in the electrolytic hydrogen system during peak periods.

The possibility of operating such cells with either fossil fuel or hydrogen results in significant advantages from the standpoint of stabilizing the operation of the reformer(relative to the hydrogen production plant) over extended periods of time; the possibility of storing the hydrogen (for example) in hydride beds obviates the need for continual stops and starts to follow the load variations on the consumer-power generating system.

As regards electrolyzers, a more complex dual mode scheme combines this equipment--as single-output units--with dual-input (hydrogen/fossil fuel) fuel cells. This arrangement associates batteries of electrolyzers, which then produce the hydrogen, with a storage plant (like the 26-MW(E) one described above). The hydrogen is stored and then used in the fuel cells during maximum-load periods, whereas fuel oil or natural gas are supplied to the fuel cells during periods of medium power loads.

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capacity as a function of the installed nuclear electric power generating plants (as correlated by the Public Service Electric and Gas Co.[3]), and data relative to projected costs and efficiencies of electrolyzer equipment (under current technological development).

A more advanced concept, capable of providing a closer integration between the electric and gas distribution networks, combines dual-output electrolyzers with dual-input fuel cells. In this arrangement, excess hydrogen produced can be introduced into the gas distribution system, or gas can be drawn from the gas network to produce electric power, depending on the variations in demand for electricity and gas.

High-capacity storage plants can be used simultaneously to actualize the concept of seasonal storage. Such a system can be configured in two different manners.

The first of these is based on grouping all the principal components, namely, electrolyzers, fuel cells and reformer, in a single plant site.[4]

The second is based instead on distributing the components over the electrical transmission network, requiring in particular that the electrolyzer equipment be located in high-load-factor electric power substations and in the vicinity of central gating plants in the natural gas distribution network, whereas the fuel-cell batteries (installed near electric power transmission substations) should contribute to augmenting the available power in critical electrical load zones.

The advantage and innovation represented by this solution is in the possibility of utilizing the gas distribution network as a hydrogen storage system.

Recapitulating, the constant common to all the dual mode schemes described lies in the dual possibility of introducing electrolytic hydrogen into the gas pipeline and withdrawing from the gas network a fuel suitable for burning in the fuel cells after converting it into hydrogen. This concept, if rendered operative and if certain peripheral conditions are met, like the solution of certain technological problems, could enhance optimization of energy supply on a vast scale.

In this regard, a brief mention is warranted concerning the studies in progress on the electrolysis of hydrochloric acid, which could lead to the overcoming of several obstacles, such as the low efficiency and high costs of a storage system based on the electrolysis of water, that derive from the irreversibility of the reaction that occurs at the oxygen electrode (low efficiencies), to the different catalyzers required for the production and oxygen reduction phases, and consequently to the need to resort to different components for the two phases (electrolyzers and fuel cells).

The use of hydrochloric acid in a closed-cycle system, in which the chlorine produced is stored to be used in the subsequent reduction phase, can offer various advantages such as: a single equipment installation for the oxidation and the reduction of the chlorine; high efficiency of the system ($\simeq$70 percent), owing to the quasi-reversibility of the reaction at the electrodes; the possibility of electrolyzing water with the same equipment provided for electrolyzing the chlorine; a good body of knowledge of chlorine technology; low operating temperatures.

Compared with systems based on electrolysis of H_2O, an HCl plant should exhibit greater viability of costs and greater flexibility of use.

Conclusions

The storage of electric energy in the form of hydrogen and the subsequent conversion of chemical energy into electrical energy, although attractive, are not yet commercially viable because of the lack of commercial fuel cells.

Therefore, until the technological state of the art relative to these components, or other incentives such as a substantial further increase in the price of fossil fuels, make their use more widespread and economically viable, the systems described herein can only fulfill a marginal role in the total energy economy.

If, however (as now seems probable), these conditions come about, the use of flexible storage systems (like those described herein), that are clean and reliable, can produce very substantial economic benefits in addition to resolving specific problems like that of the availability of electric power at peak moments.

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NEW STEELMAKING TECHNIQUE COMMERCIALLY FEASIBLE

Stockholm DAGENS NYHETER in Swedish 13 Dec 79 p 34

/Article by Lasse Hoglund: "New Steel Technique; Asea and Stora Want to Build in Lulea"/

/Text/ Stora Kopparberg and Asea are negotiating with the state to be allowed to construct a first full-scale plant for production of steel according to the new Swedish so-called Elred method. A smelting plant for about 300,000 tons at a cost of approximately 400 million crowns at SSAB /Swedish Steel, Inc./ in Lulea is considered nearest at hand.

"The process has been well tested, and now it is time for the first large commercial plant. We need a full-scale pilot plant in order to be able to sell the process all over the world," managing director Erik Sundblad at Stora Kopparberg said at a press conference in Vasteras on Wednesday.

Since the Elred process is a Swedish invention which could be of great importance to the Swedish steel works, Stora Kopparberg and Asea believe the first plant ought to be built in Sweden. SSAB is also said to have declared itself extremely interested, but due to its large losses it has no money of its own to invest.

Additional government funds are needed for that and this is why Stora Kopparberg and Asea have been negotiating for some time with the Department of Industry regarding this matter.

Separate Company

"The Elred process would be an excellent example of government handling of a new technique, the same way the state supported the first direct current transmission to Gotland and the building of the first nuclear power plant," Erik Lundblad said.

He believed that the state should form a special company together with Stora Kopparberg and Asea in order to build the new smelting plant, perhaps patterned after the model of Swedish Steel, in which the state owns half and Stora Kopparberg and Granges one-fourth each. These questions have not yet been decided, however.

It also has not been decided where the new plant is to be located.

Within SSAB, however, the steel production in Lulea has the best prospects. It also has a metallurgical center and furthermore the municipal region is planning a thermal power plant which could be built in conjunction with the smelting plant.

The Elred process (electrical reduction) is a new way to produce raw steel which is about 20 percent cheaper than the blast furnace technique predominant up to now.

Secret for Six Years

The method was revealed over a year ago, but Stora Kopparberg and Asea had then been working on it in the greatest secrecy for 6 years. Up until today the project has cost about 40 million crowns.

Stora Kopparberg and Asea have formed a joint company in order to develop the ideas, Elred Engineering AB, which so far has built a large pilot plant at Asea in Vasteras and conducted other experiments at the Domnarvet iron works.

In traditional iron production the iron ore is ground to a powder, ore concentrate, which is then sintered (made to stick together) to a porous cake which is then crushed again. At the same time hard coal is converted to coke before both materials are mixed in the blast furnace and the iron smelted out.

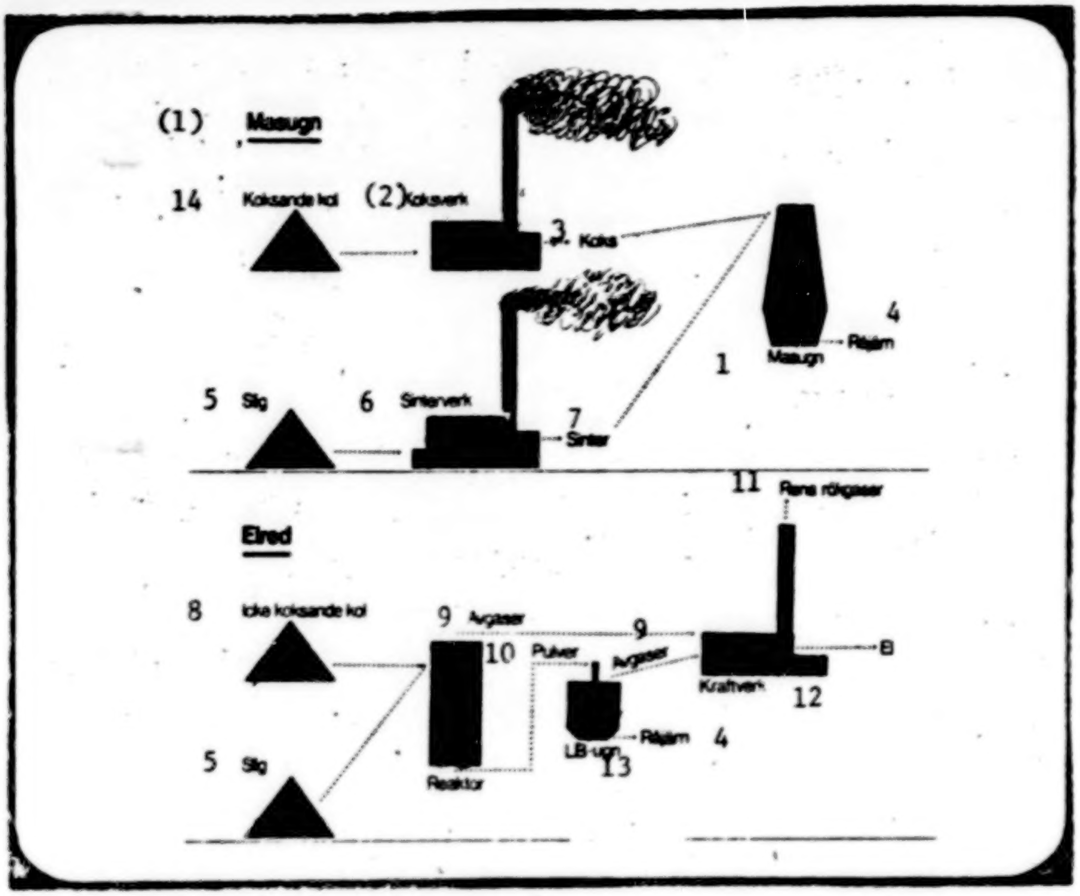
With the new method both the sintering plant and the coke plant are eliminated and with them great environmental disturbances as well. The ground iron ore, the continuous casting, is mixed directly with crushed hard coal and in the first step heated to a partially metalized product, with some residual coal.

Raw Iron

In the next step the oxygen is reduced out and the product smelted in a new type of electric arc furnace into raw iron. The method is particularly suitable for Swedish ore which often contains phosphorus and is otherwise difficult to work with. It is also possible to use ordinary coal which is much cheaper than so-called coking coal required in blast furnaces.

The combustible gases formed during the process are purified and used for power production in gas and steam turbines. The electric power produced is sufficient both for smelting the iron and for nearly half of the requirement of a rolling mill attached to the plant.

The simplified process and the lower energy costs are thus the reasons why the iron becomes about 20 percent cheaper than if produced in a blast furnace.



The new so-called Elred method for producing raw iron (at bottom of picture) becomes approximately 20 percent cheaper than the present blast furnace technique by eliminating sintering plants and coke plants. Elred also functions as a coal-fired power plant which delivers more electric power than needed in order to smelt the iron.

Key for chart:

1. masugn = blast furnace
2. koksverk = coke-oven plant
3. koks = coke
4. rajarn = "raw iron"
5. slig = ore concentrate
6. sinterverk = sintering plant
7. sinter = sinter (roasted iron ore)
8. icke koksande kol = non-coking coal
9. avgaser = exhaust gases
10. pulver = powder
11. rena rokgaser = clean stack gas, chimney waste
12. kraftverk = power plant
13. LB-ugn = LB-oven
14. koksande kol = coking coal

"This is a tremendous advantage for Sweden," Erik Sundblad says, "just as the fact that the process could become profitable on a rather small scale. In order to achieve profitability for steel based on the blast furnace method it is necessary to produce at least 5 million tons, which is the equivalent of the entire Swedish market."

"If Sweden could rapidly adopt the new technique it would be a tremendous competitive advantage. Investments in steel works are so expensive that it takes a long time before a new technology makes a breakthrough. For example it took 20 years before rod casting represented half of the world production."

The export market is considered enormously great. The world's steel industry is "crying for a method to replace the many hundred year old blast furnace process," as Erik Sundblad said.

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